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ABSTRACT

An informal progress report of the PLATO IV computer-assisted instruction (CAI) system briefly discusses the important features of the system and attempts to give some idea of the systems costs, reliability, and problems. The author presents his rationale for the use of PLATO IV as the major component in a three year program designed to develop a CAI program for Medicine and Allied health science instruction. A brief review of the proposed program, to be developed by the School of Basic Medical Sciences at the University of Illinois, is accompanied by some preliminary cost estimates. The views expressed in these two reports are those of the author. (JY)

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PLATO IV: A User's Overview

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Introduction.

This is an informal report of the progress of PLATO IV. The author is simply one of many PLATO users--a physician, neither a computer scientist, nor a member of the PLATO parent organization. The views expressed are strictly his and do not necessarily correspond to those of that organization.

PLATO is a rapidly changing system so that any numerical estimates included here are only the best available as of 1 August 1974 and are liable to sudden change. The history, motive, and plan for PLATO are documented in other papers[1-3]. The objective of this presentation is to describe present performance and to hazard a few conjectures about costs.

When overview reports are written by a principal manager of the system which is the subject of the report, readers should be careful to distinguish projections about the future from the accomplishments of the present. In this paper, a sincere effort to highlight the distinction will be made even though the author is not a principal in PLATO.

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The User Community

The most important news about PLATO is that it is serving a large group of users an average of over 23 hours per day every day. There are now about 500 terminals installed in 75 different locations. This makes PLATO one of the largest interactive time-sharing systems in existence, in terms of the number of terminals and by the geographic spread. At peak hours, it is not unusual to have 225 simultaneous users.

The original plan was to deploy the terminals in large groupings so that communication lines could be set up efficiently. However, many geographically dispersed groups expressed a desire to try PLATO. To accomodate them, the Computer-based Education Research Laboratory (CERL) established a larger number of sites--some of which have as few as one terminal, other of which have as many as 37 (and will still grow). PLATO terminals are now operating in 18 states, Canada, and experimentally in Europe. The number of terminals in this version of the system has been reduced from a planned 4000 to approximately 1000 in the light of experience gained with the existing system load.

Most PLATO users are in schools but a few terminals are being used experimentally in business, scientific research, and medical data base management. Terminals were allocated preferentially to the largest financial supporters of PLATO--the Community College and Elementary Education programs funded by the National Science Foundation, the Military Training Centers program funded by ARPA, and the University of Illinois. Other terminals were sold or loaned to many small groups whose activities were of research value. The current allotment of terminals is nearly all assigned. After the remaining few terminals are gone, participation in the PLATO program will be possible only by borrowing terminal time at an existing site or by entering a sharing program such as that of the School of Basic Medical Sciences which is described in another paper in this proceedings.

User/Network Interface

A number of important characteristics have been incorporated into the PLATO system to optimize it for education. Many PLATO users have come to feel that any computer system which is proposed for use in education should have at least these capabilities.

Access protocol is at a minimum. The system is organized functionally into "courses" and every participant is identified with such a course in a roster. All any user needs to do is to sign in with his name, course and a personally chosen password. (S)he will then be recognized automatically as an author, instructor, or student and will have corresponding priviledges.

All lessons on PLATO are identified by file names made up by the authors. Authors can gain access to files by entering the file name on one of two displays--the "author mode" display gives the user access to the computer program for the lesson while the "student mode" display permits the users to execute the lesson as a student. Instructors can request lessons only in "student mode", but they have access to the roster for the students in their course. Students do not request lessons by file name. Their access to materials and the sequence in which they can see them is controlled to any desired degree by index pages composed by the director of each course.

Sign-on procedure requires about five minutes of instruction and for very young students can even be further automated.

Any PLATO terminal can be used to execute lessons or to write programs--even at the system level--if the user has the correct name, course and passwords. Of course, systems programmers have access to features beyond those available to author, instructor, or student categories.

The user/system interface.

By user/system interface is meant the means of communications between the user and the computer via the terminal and its accessories. The details of this facet are given in other reports[3] however the highlights of the PLATO terminal's capabilities are:

1. Computer generated graphics.
2. Special character sets of great versatility--any alphabet or type face can be written on PLATO and characters may be user-designed or obtained from an extensive on-line library.
3. Displays may be animated.
4. Any items on a display may be erased and/or modified without altering the rest of the display.
5. Computer graphics may be superimposed over color microfiche on the same screen. Each 4" x 6" fiche contains 256 frames which can be accessed in any order within 0.2 seconds under program control.
6. A touch-sensitive panel with 0.5" resolution (for children who are too young to have learned to type and physicians who are too obstinate to try).
7. A random-access audio device under rapid computer control.
8. A "hard-copy" printer--one type yields copies of the computer programs, the other produces facsimiles of the screen displays.

The TUTOR editor is the software part of the interface and represents one of the most flexible and friendly PLATO assets. With this editor, authors can make minute as well as extensive changes in their programs at any time. They can generate special characters and graphic displays interactively--the computer furnishes all of the formating instructions after the author is satisfied with the display that (s)he has created. A comprehensive library of information

about the use of the author language TUTOR is directly available from the editor with automatic return to the lesson.

Hardware

PLATO is currently run on a CDC Cyber 73 with a considerable amount of extra peripheral equipment some of which is custom-made at the CERL. PLATO terminals are made under CERL license by Magnavox and the plasma display screen is manufactured by Owens-Illinois.

Communications between the terminals and the computer.

Most PLATO terminals are now connected over telephone lines. Those outside of the immediate Urbana area use full-duplex voice grade long distance lines. Two types of couplers are available--one accomodates a single terminal while the other style permits multiplexing four terminals to one line. The most economical transmission method has only recently become available. It is microwave emmission of the signal from computer to terminal with telephone line return of information to the computer. Returned data is transmitted at a sufficiently low rate to permit 32 keysets to be multiplexed on a single phone line. Microwave channels can accomodate a large number of terminals however their availability is still limited due to monopolies which are still being litigated in court. The range of a single typical station is 15-25 miles but the signal is easily relayed. A microwave link now connects the PLATO computer with classrooms at Chanute Air Force Base near Rantoul, Illinois.

Software

For practical purposes TUTOR is the only software available to PLATO users. However, other languages can be run for research purposes and there are several simulations of other computer languages on PLATO as a part of the computer sciences curriculum.

TUTOR is intended for education. Calculating in TUTOR is not unlike FORTRAN, but the similarity stops there. The answer judging routines which are completely automatic with TUTOR are of particular value in medical teaching. One of these is an algorithm which checks for word order, spelling errors, and extra words. If these specific errors are found, the answer is not simply refused but the nature of the mistake is indicated to the student by a unique markup on the display. It should be emphasized that this feature requires no commands or other action on the part of the author beyond the routine instructions which specify the judging of student responses. There are also TUTOR commands which simplify specification of synonyms and relationships between words. These allow the writing of extremely "deep" English language dialogs with an economy of time on the part of the author and of the computer. Storage space in comparison to a similar Coursewriter program is much less.

Communications between PLATO users.

PLATO provides extensive on-line and stored communications between users and with consultants. Consultants are available on-line during prime time hours and frequently at other times as well. To obtain one, a user simply types a request at the terminal and if a consultant is on the system, (s)he will be immediately notified by a message at the bottom of the screen. The consultant and client then communicate by writing on the bottom lines of the screen (visible to both participants) or by the monitor option which permits the display screens of the communicating parties to be slaved by mutual consent. Organized dialogs on problems of interest are carried out in TUTOR notes which is available at all times on-line. "Talkomatic" is an option which permits five participants to share a screen display seen by all and on which each can write and erase four lines of text--much like a telephone conference call. Naturally, the participants may be scattered geographically.

Costs

It may surprise some computer users that PLATO's fees are not based on any measurement of "connect" or processing time. This is feasible because the time-sharing design automatically limits each terminal to its proper share of the computing resources. It is a reasonable approach because students spend relatively little time processing information and a great deal of time just reading it off the display screen and thinking--which require no computer time at all. It is the only rational approach to educational computing because it would be immensely distracting to students to involve them actively in budgeting of the terminal time and computer resources. A careful analysis of this approach in an analogous system at Dartmouth has recently been reported[4].

The bulk of PLATO activities are currently supported by aforementioned grants. However, already looking to the day when these will expire, the CERL has proposed service charges on a yearly basis--to include computer time and terminal servicing (exclusive of any travel costs). The proposed rate is around $1500 per terminal per year. Projecting future operational costs is an uncertain passtime, however, on the basis that an educated guess is better than no information at all:

1. Capitalization. The cost of the computer, terminals and other "standard" hardware would run between $6000 and $10,000 per terminal (including the cost of the computer itself distributed over an assumed 1000 terminals and including storage on disc of 2000 lessons).

2. Service fees already are estimated at $1500 a year per terminal including all maintenance, computer time and consultant services. If one amortizes hardware costs over only five years and assumes 4000 hours a year of use per terminal, the costs are:

	cost per terminal per year	cost per contact hour
hardware	$2000	.$0.50
services	$1500	0.38
Total	$3500	$0.88

This excludes the following:

3. Communications. This is the most variable and troublesome factor. If regional PLATO installations are established, it will be almost negligible; if long distance phone lines are needed for cross country communications, the fees can be very high. A further treatment of this topic appears in a description of the proposed basic health sciences PLATO mini-network--a separate paper in this proceedings.

4. Courseware is also a highly variable item in the cost accounting area. Estimates have ranged from $200 to over $3000 per student-contact hour. The best current guess for the Basic Medical Sciences program on PLATO is $1000. This compares well with other media--a TV film commercial can cost $20,000 for a mere 30 seconds and many audio-visual "one hour instructional packages" have cost well over $2500 each. The key to lowering the cost of courseware per student-hour of use clearly lies in widespread sharing of these materials. The cost of author royalties must also be included.

When all factors are considered, it seems reasonable to put the total cost per hour of PLATO instruction at between $1 and $2 an hour in an operational system. This is a rough prediction at best.

Course materials.

There are now over 2200 hours of instruction available in more than 60 content areas. About 1000 more hours in 40 additional areas are under development. The best way to appreciate the depth of the available materials (from Accounting

to Zoology) is to borrow a PLATO terminal and examine lessons "sample" and "catalog" but the second best way is to read reference 5.

Reliability

PLATO IV is a system in which operational users co-exist with research activites. Despite this dichotomy, operating reliability for hardware is quite good. Some typical figures are:

Mean number of prime time users (July 74)	126
Mean number of users (24 hour basis) (July 74)	85
Mean time to interruption (July 74)	5.4 hours
Mean time to interruption (August 74 to date)	9.9 hours
Probability of interruption during one hour class (July 74)	0.17
Mean duration of interruption (July 74)	0.14 hours
Mean hours to terminal failures (July 74)	626 hours
Mean delay to accomplish repair (July 74)	3.6 hours
Percent prime time available (July 74)	97.2%

Problem areas

The medical descriptions of current problems with PLATO would probably be "growing pains". There are still problems of authoring quality courseware and getting faculty acceptance--concerns shared by all CBE systems. Student acceptance on the other hand has never been much of a problem with PLATO.

Part of current difficulties with growth are due to the user's expectations of near-instantaneous response and apparently limitless storage space. The only delay which increases appreciably with increasing numbers of uses is the brief wait experienced after a request for a lesson. PLATO lessons are now stored in "human readable" program form (source code) for instantaneous editing at all times. But for execution they must first be translated into "machine-executable" code--a specialized compiling-like process which requires a huge

processing time (several seconds per lesson). This situation will resolve when, in a few months, lessons will be stored in executable ("binaries") as well as editable form.

References

1. Alpert, D. and Bitzer, D. L.; Advances in Computer-based Education. Science 167:1582, 1970.

2. Lyman, E. R.; PLATO Highlights; CERL Report May 1974 available from CERL, University of Illinois, Urbana, Il; 61801.

3. Bitzer, D. L., Sherwood, B. A., and Tenczar, P.; Computer-based Science Education; CERL X-37 (1973). Available from CERL, University of Illinois, Urbana, Il; 61801.

4. Luehrmann, A. W. and Nevison, J. M.; Computer Use Under a Free-Access Policy. Science 184:957+, 31 May 1974.

5. Lyman, E. R.; PLATO IV Curriculum Materials CERL Report X-41, Feb. 1974. Available from CERL, University of Illinois, Urbana, Ill; 61801.

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A Basic Science PLATO IV Network for Medicine and Allied Health Instruction

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INTRODUCTION

In July 1973 the School of Basic Medical Sciences of the University of Illinois at Urbana-Champaign (SBMS-UC) received a three-year grant from the National Institutes of Health to develop a computer-based education (CBE) program complementary to the self-instructional curriculum of the School. One of the most compelling advantages of CBE is that instructional materials can be widely shared among a large group of users because computers communicate readily with relative disregard to distance. One might then expect that medical CBE would be widely used in American medical schools, but in fact it is still highly experimental and to a large extent unsatisfactory and suspect. Recent objective studies of this question have revealed several important factors which tend to decrease the use of CBE: [1,2]

1. Inability to share materials--due to incompatible computer "hardware", languages and course organization.
2. Redundancy in "popular" areas and poor coverage in other subjects--due to absence of a development plan.

3. Poor lesson quality--on systems where lessons do not undergo standardized design and review procedures.

4. Poor accessibility--because often no catalogs exist.

5. Frequent student frustration--with equipment malfunction, long service intervals, bizarre requirements for interaction with the machine (in addition to items 1 to 4 above).

These difficulties can be overcome by close cooperation between users. Why then, has such cooperation been so difficult to obtain? The fundamental reason may be that the computers and author languages now in most frequent use in education are not effective enough for the task. This is not to say that high quality instructional material doesn't exist in medical CBE. Outstanding examples of medical CBE have been written on many different machines with a variety of languages. However, the effort expended has been too much for the results obtained.

Student and faculty time and everyone's money are heavily overcommitted. Therefore, if a heroic effort is required to write high quality instruction on a system, few good lessons will ever be written on it. Limitations of the display, author language and computing power of most systems drastically restrict the choices of instructional strategy and content which an author can make. These restrictions inhibit the whole process of authoring and using computer-based lessons. Some unhappy users are so resigned to the limitations of the system they are using that they have overlooked the system itself as the most likely source of the frustration they feel about CBE in general.

The computer-based education project which is the subject of this report uses the University of Illinois' PLATO IV system. The PLATO computer, its terminals, and the author language are all designed and optimized expressly

for education--hence they go far to eliminate the usual technical impediments to CBE. The use of PLATO frees authors and students from many previous limitations by offering a wide variety of graphic and text displays, branching and answer-judging capabilities.

PLATO IV may be the first computer system which is worthy of the time and effort which must be spent to develop high quality instructional material--but good equipment alone is not enough to insure acceptance of CBE and cooperation by faculty and students. In addition, the system must be shown to display economy, valid instructional design, methodical (but uninhibited) development and a high degree of quality control, in order to satisfy critical users of CBE.

SBMS-UC staff realize that the above objectives are hard to meet with a single faculty group of limited size, concentrated in one location. Just as important, many medical schools urgently need to get direct, intimate experience with CBE in order to be able to make important decisions about the technology they will use in the near future. Thus SBMS-UC is sponsoring a limited and structured sharing of the development and use of basic health sciences lessons on the PLATO IV system.

The proposed "mini-network" will feature:

1. A single, reliable, powerful computer system (PLATO IV) controlling versatile "intelligent" terminals located at varying distances and communicating by telephone lines.

2. Uniform cataloging, evaluation, planning and review procedures, as well as consistent "programming standards", which will guide the authors in the correct use of the computer's capabilities and prevent student confusion.

3. A reasonably paced, non-redundant, broad-scoped schedule of lesson development involving several schools in the writing and review process.

4. A panel of reviewers and consultants (including professors and students from several institutions and medical practitioners) who will insure lesson quality and attractiveness.

5. A pool of medical students who will take the lessons for their own benefit while providing evaluation data which will be collected by the computer.

ESSENTIALS OF THE PROGRAM

SBMS-UC will supply participating schools with PLATO IV terminals, computer "connect" time, many additional support items and all basic health sciences instructional modules which are on the PLATO system. All participants will contribute mutually-agreed upon course materials. All "lessons" will go through a formal peer review and student evaluation process before they are released for widespread use.

This project gives interested schools an opportunity to get direct hands-on experience with modern computer based education with an almost negligible investment.

WHAT SBMS-UC WILL PROVIDE

A. Terminals

Initially, each school will receive a single terminal. Later, two of the participants will receive three additional terminals each.

B. Access to Lessons.

All participants will have access to all finished instructional modules in basic health sciences (eventually to reach over 500 student contact hours). Many remedial lessons* as well as instruction outside of basic health will also be available on the system.

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*in biology, metric system, chemistry and physics

C. The Author Language, Training and Consultation.

TUTOR is a uniquely versatile programming language developed specifically for PLATO. It is especially suited to writing instructional programs. From experience, the first several weeks of TUTOR training are most easily administered by direct intensive contact with the terminal and an instructor. SBMS-UC will arrange for training of personnel from other schools at Urbana-Champaign.

D. Communication between users.

SBMS-UC will handle distribution of written materials to users. There will be also a "bulletin board" and "message file" within the computer's memory which will be accessible from each PLATO terminal. Thus users will be able to transmit information to each other rapidly and at no cost. "Talk" options, a PLATO systems feature, are available for teletype-like instant inter-terminal communication. Cross country conferences with up to five participants are easily arranged.

F. Contributors Meetings.

SBMS-UC will host regular (biannual?) meetings of representatives from contributing schools. Some "scholarship" funds will be available for participants requiring support for their attendance.

G. Written support materials and microfiche.

SBMS-UC will supply TUTOR manuals to all participating schools. In addition, a PLATO systems lesson, "aids", which contains up-to-date descriptions of TUTOR commands and other useful information is always available from the computer at every terminal.

SBMS-UC has drafted: 1) programming standards, 2) lesson development protocols and 3) proposed review procedures. Suggestions and comments from prospective users will be incorporated in future editions. SBMS-UC will arrange

for preparation of microfiche* monthly from a compiled group of all 35 mm transparencies supplied by contributing schools. The fiche will be made available at cost. SBMS-UC will also provide directories, bibliographies and other materials of general interest, and of help to authors.

H. Number of Participants.

The University of Illinois Colleges of Medicine at the Medical Center (Chicago), Peoria, and Rockford will participate. Five additional institutions will be chosen from the applicants.

COSTS

1. Terminals.

The terminals will be loaned to participating schools through the SBMS-UC Medical Computing Laboratory, each participant will receive:

a. The terminal, key set, and MODEM*: b. computer time (23 hours per day service), and c. training and consulting as needed. A service fee of $4000 per year per terminal will be charged (see below - item 3 - for rebates of this fee). This is based upon the requirements of the Medical Computing Laboratory and should not be interpreted as the projected cost of operation of an "operational" PLATO system.

2. Phone Lines.

Participating schools will pay all of their communication costs (telephone lines to the computer at Urbana). These costs vary according to distance and the type of telephone service obtained. Specific information can be obtained from the phone company. The costs of the line when four terminals are multiplexed on it are substantially the same as those for single-terminal connections, hence considerable savings can be realized if the phone line is

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* The PLATO system features full color slide presentation from microfiche with superimposed computer graphics (see appendices).

* MODEM: Modulator/demodulator needed to couple the terminals and computer to phone line.

used for a multiple installation or shared with other PLATO users in the same calling area.

3. Cost-sharing by SBMS-UC.

a. SBMS-UC will furnish the first terminal free of any charge for schools which wish to join the program, but are unable to generate funds for the lease fees. These schools must write to SBMS-UC a letter which certifies that they have tried to secure the service funds for the first terminal without success and they must document the contention that they are still trying to obtain funding.

b. Decisions whether or not to accept a proposal to participate will be made without reference to a school's ability to pay for their first terminal.

COSTS PER UNIT OF USE

A single terminal, properly scheduled, will yield an excellent exposure to PLATO for both students and instructor/authors. An estimate of the hourly costs of such a site and of a four-terminal installation is given in figure 1 in which it is assumed that the full service fee of $4000 a year is paid by the participant (i.e. a free terminal is not considered) and it is further given that an expensive phone line is needed. Of course, an operational PLATO terminal would be an order of magnitude cheaper to operate.

Figure 1. Cost-effectiveness of typical experiment health sciences PLATO site

Assumptions: 1 terminal yields 4000 hours per year of which 1/2 is student time
4 terminals yield 14000 hours per year of which 5/7 is student time
Distance such that phone cost = $1000 month (relatively high)

1 terminal site

	Per year	Per hour	Per student-contact hour
Service charge for terminal ($)	4,000	1.00	2.00
Communications ($)	12,000	3.00	6.00
Total ($)	16,000	4.00	8.00

4 terminal site

	Per year	Per hour	Per student-contact hour
Service charge for terminal ($)	16,000	1.14	1.60
Communications ($)	12,000	0.86	1.20
Total ($)	28,000	2.00	2.80

GUIDELINES FOR PARTICIPANTS

In addition to the cost provisions discussed previously there is only one other absolute requirement for participation: each site must have an individual who has thorough knowledge of the TUTOR language and a basic understanding of the PLATO system architecture. The designated person may be either in computer sciences, education, or a content field but (s)he must devote one half to full time to PLATO development. Without this minimum, any significant productive interaction would be unlikely.

To prevent any infringement of academic freedoms, there are no further formal prerequisites. Rather, SBMS-UC would like to hear from prospective participants the ways in which they wish to contribute. This would be most conveniently communicated by an informal, perhaps draft-form, written proposal. The task of selecting participants would then be one of matching participants with areas of particular ability and interest to the program requirements. SBMS-UC would then rank the proposals in order of desirability to the overall program and would release terminals to the participants in sequence.

There are at least three ways in which contributions can be made: 1) writing and programming of instructional modules 2) review of already designed modules 3) collection of student-interaction and performance data. Proposals should include all three.

Proposals should be as specific as possible about the qualifications of participating persons, the amount of release time they will be given, and the instructional material they plan to write.

Current Status

As of 1 August 1974, four high quality proposals have been received and several other institutions have expressed interest. Current plans are to choose three participants around September 1974 and two more in December 1974. The sites to receive additional terminals would be selected in January or February 1975. For further information, readers are urged to contact the author. Applications are still solicited as of the date of writing.

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References

1. Casbergue, J. P.; Guidelines for the Development of CAI in Health Professional Education Programs. (Unpublished doctoral thesis as of February 1974).

2. Hickey, A. E.; Research guidelines for CAI; presented at ADCIS, Washington, DC, January 1974.